# Biological Sciences (BS): Molecular, Cellular, and Developmental Biology (17BIOSCBS-17BIOSCMCD)

## Freshman Year

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Credit</th>
<th>Spring Semester</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSC 101 Critical Creative Thinking Life Sci*</td>
<td>2</td>
<td>BIO 183 Intro Bio: Cellular &amp; Molecular</td>
<td>4</td>
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<tr>
<td>BIO 181 Intro Bio: Ecol, Evol, Biodiversity</td>
<td>4</td>
<td>CH 221 Organic Chemistry I</td>
<td>3</td>
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<tr>
<td>CH 101 Chemistry-A Molecular Science</td>
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<td>CH 222 Organic Chemistry I Lab</td>
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<tr>
<td>CH 102 General Chemistry Lab</td>
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<td>ENG 101 Academic Writing &amp; Research*</td>
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<tr>
<td>MA 131(^1) Calcul. Life &amp; Mgmt Sci. A</td>
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<td>MA 231(^1) Calculus Life &amp; Mgmt Sci. B</td>
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<tr>
<td>LSC 103 Exploring Opportunities Life Sci</td>
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<tr>
<td>GEP Health &amp; Exercise Studies Req*</td>
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## Sophomore Year

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<tr>
<th>Fall Semester</th>
<th>Credit</th>
<th>Spring Semester</th>
<th>Credit</th>
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<tbody>
<tr>
<td>BIO 250 Animal Anatomy &amp; Physio(^2)</td>
<td>4</td>
<td>GN 311 Principles of Genetics</td>
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<tr>
<td>CH 223 Organic Chemistry II</td>
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<td>GN 312 Elementary Genetics Lab</td>
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<tr>
<td>CH 224 Organic Chemistry II Lab</td>
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<td>CH 201 Chemistry-A Quantitative Sci.</td>
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<td>Free Elective(^3)</td>
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<td>CH 202 Quantitative Chemistry Lab</td>
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<td>GEP Social Sciences Requirement*</td>
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<td>GEP Interdisciplinary Perspectives Req*</td>
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<td>GEP Health &amp; Exercise Studies Req*</td>
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<td>Learning Experience Elective(^6)</td>
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## Junior Year
### Fall Semester

<table>
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<tr>
<th>Course</th>
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<th>Course</th>
<th>Credit</th>
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<tbody>
<tr>
<td>PY 211 College Physics I</td>
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<td>PY 212 College Physics II</td>
<td>4</td>
</tr>
<tr>
<td>BIO 361 Developmental Biology OR GN 434</td>
<td>3</td>
<td>Cell Biology Requirement</td>
<td>3</td>
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<tr>
<td>BCH 351 OR 451 Biochemistry</td>
<td>4</td>
<td>BIT 410 Manip of Recombinant DNA</td>
<td>4</td>
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<tr>
<td>Advanced Writing Requirement</td>
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<td>GEP Humanities Requirement*</td>
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<tr>
<td>GEP Humanities Requirement*</td>
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### Spring Semester

<table>
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<th>Course</th>
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<th>Course</th>
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### Senior Year

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Credit</th>
<th>Spring Semester</th>
<th>Credit</th>
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</thead>
<tbody>
<tr>
<td>MCD Elective^8</td>
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<td>MCD Elective^8</td>
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<td>MCD Elective^8</td>
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<td>Science and Math Elective^7</td>
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<tr>
<td>Science and Math Elective^7</td>
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<td>GEP Social Sciences Req*</td>
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<tr>
<td>GEP Additional Breadth Req*</td>
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<td>Free Elective^3</td>
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<tr>
<td>Free Elective^3</td>
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Minimum Credit Hours Required for Graduation: 120

### MCD Footnotes

A grade of C- or better is required in the following courses:
- LSC 101 Critical and Creative Thinking in the Life Sciences
- BIO 181 Introductory Biology: Ecology, Evolution, and Biodiversity
- BIO 183 Introductory Biology: Cellular and Molecular Biology
- BIO 361 Developmental Biology or GN 434 Genes and Development
- BIO/PB 414 Cell Biology
- BIT 410 Manipulation of Recombinant DNA
- BCH 351 or 451 Biochemistry
- GN 311 Principles of Genetics
- GN 312 Elementary Genetics Lab

Physiology Requirement^2
- MA 131 Calculus for Life and Management Sciences A
- MA 231 Calculus for Life and Management Sciences B
Taking courses for credit only (S/U): PE, Free Electives and courses offered only for S/U credit can be applied to graduation requirements. Students should check with their adviser before electing to take any course that normally is graded A-F as an S/U course.

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1. **Mathematics Alternatives**
   MA 141 and MA 241 is a suitable substitute for MA 131 and MA 231.

2. **Physiology Alternative**
   BIO 212 or BIO 240 or BIO 245 can be substituted for BIO 250.

3. **Free Electives (take 12 credit hours)**
   These electives cannot be remedial nor can they be taken at an elementary level after you have taken comparable coursework at a more advanced level. ST 311 is recommended as a Free Elective. Students interested in graduate school or professional school should check the courses required for admission to the programs to which they plan to apply.

4. **Physics Alternatives**
   PY 205 and PY 208 can be substitutes for PY 211 and PY 212. PY 205 and PY 208 are calculus-based and require that you take the 40 series of Mathematics\(^1\) (MA 141 and MA 241). PY 201 and PY 202 would also be a suitable substitute for PY 211 and PY 212. PY 201 and PY 202 are calculus-based, require the 40 series of Mathematics\(^1\), and are restricted to students in PAMS.

5. **Advanced Writing Requirement (take one course)**

6. **Learning Experience Elective (take one course for 3 credit hours)**
   Learning experience in an appropriate area (research, teaching, or other professional experience), with prior approval by faculty adviser, prospective supervisor, and departmental undergraduate coordinator. Contact and arrangements with prospective supervisors is the responsibility of the student. Talk to your advisor about this requirement.

7. **Additional Science & Math Electives (take 8 credit hours)**
   Course may be selected from the Sci & Math Electives list. Students also can use up to 3 hours of AEC 450, BEC/BIT 463, BIO 269, BIO 230, BIO 310, BIO 416, BIO 418, BIO 432, BIO 444, BIO 456, BIO 492, BIO 493, BIO 498/499 (must complete both), BIT 477, GN 453, MA 331, MB 470, ZO 334, or ZO 486 toward this requirement. Students interested in graduate school or professional school should check the courses required for admission to the programs to which they plan to apply.

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8. **MCD Electives (take 9 credit hours)**
BCH 452 Introductory Biochemistry Laboratory
BCH 453 Biochemistry of Gene Expression
BCH 455 Proteins and Molecular Mechanisms
BIO 310 Quantitative Approaches to Biological Problems
BIO 370 Developmental Anatomy of the Vertebrates
BIO 375 Developmental Anatomy Laboratory
BIO 405 Functional Histology
BIO 418 Cell Biology Lab
BIO 421 Advanced Human Anatomy and Physiology
BIO 426 Advanced Human Anatomy & Physiology Lab
BIO 482 Capstone Course in Molecular, Cellular, and Developmental Biology
BIO 488 Neurobiology
BIT 462 Gene Expression Analysis: Microarrays
BIT 463 Fermentation of Recombinant Microorganisms
BIT 464 Protein Purification
BIT 465 Real-time PCR Techniques
BIT 466 Animal Cell Culture Techniques
BIT 467 PCR and DNA Fingerprinting
BIT 468 Genome Mapping
BIT 470 Advanced Animal Cell Culture: Bioreactor Culture
BIT 471 RNA Interference and Model Organisms
BIT 473 Experimental Analysis of Protein-Protein Interactions
BIT 474 Plant Genetic Engineering
BIT 476 Applied Bioinformatics
BIT 477 Metagenomics
BIT 478 Mapping the Brain
BIT 481 Plant Tissue Culture and Transformation
CHE 463 Fermentation of Recombinant Microorganisms
GN 421 Molecular Genetics
GN 427 Introductory Bioinformatics
GN 441/541 Human and Biomedical Genetics
GN 453 Personal Genomics
MB 351 General Microbiology
MB 352 General Microbiology Laboratory
MB 411 Medical Microbiology
MB 412 Medical Microbiology Laboratory
MB 414 Microbial Metabolic Regulation
MB 420 Fundamentals of Microbial Cell Biotransformations
MB 435 Bacterial Pathogenesis
MB 441 Immunology
MB 455 Microbial Biotechnology
MB 461 Molecular Virology
MB 470 Emerging and Re-emerging Infectious Diseases
PB 421 Plant Physiology
PB 480 Introduction to Plant Biotechnology
PB 481 Plant Tissue Culture and Transformation

9 Cell Biology Requirement
BIO/PB 414 Cell Biology
BIO 416 Cancer Cell BIOLOGY
To complete the requirements for graduation and the General Education Program, the following category credit hours and co-requisites must be satisfied. University approved GEP course lists for each of the following categories can be found at http://oucc.dasa.ncsu.edu/general-education-program/.

A. Introduction to Writing: ENG 101 (4 credit hours with a C- or better) Must be taken during the first year.

B. Mathematical Sciences (6 credit hours; one course with MA or ST prefix)
*In MCD, this GEP requirement is met through the Major course requirements.*

C. Natural Sciences (7 credit hours; include one laboratory course or course with a lab)
*In MCD, this GEP requirement is met through the Major course requirements.*

D. Humanities (6 credit hours selected from two different disciplines/course prefixes)
Choose from the University approved GEP Humanities course list. Some courses on this list will also meet the U.S. Diversity or Global Knowledge co-requisites.

E. Social Sciences (6 credit hours selected from two different disciplines/course prefixes)
Choose from the University approved GEP Social Sciences course list. Some courses on this list will also meet the U.S. Diversity or Global Knowledge co-requisites.

F. Health and Exercise Studies (2 credit hours; at least one HESF 100-level Course)
Choose from the University approved GEP Health and Exercise Studies course list.

G. Additional Breadth (3 credit hours)
Choose from the University approved GEP Humanities course list or the GEP Social Sciences course list or the GEP Visual & Performing Arts course list. Some courses on this list will also meet the U.S. Diversity or Global Knowledge co-requisites.

H. Interdisciplinary Perspectives (5 credit hours)
*In MCD, 2 credit hours of this GEP requirement is met through Major course requirements. For the remaining 3 credit hours, choose from the University approved GEP Interdisciplinary Perspectives course list. Some courses on this list will also meet the U.S. Diversity or Global Knowledge co-requisites.*

The following Co-Requisites must be satisfied to complete the General Education Program requirements

I. U.S. Diversity (USD)
Choose from the University approved GEP U.S. Diversity course list or choose a course identified on the approved GEP course lists as meeting the U.S. Diversity (USD) co-requisite.

J. Global Knowledge (GK)
Choose from the University approved GEP Global Knowledge course list or choose a course identified on the approved GEP course lists as meeting the Global Knowledge (GK) co-requisite.

K. Foreign Language proficiency
Proficiency at the FL_102 level is required for graduation.